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WEATHER CONTROL

By Professor D. W. HERING
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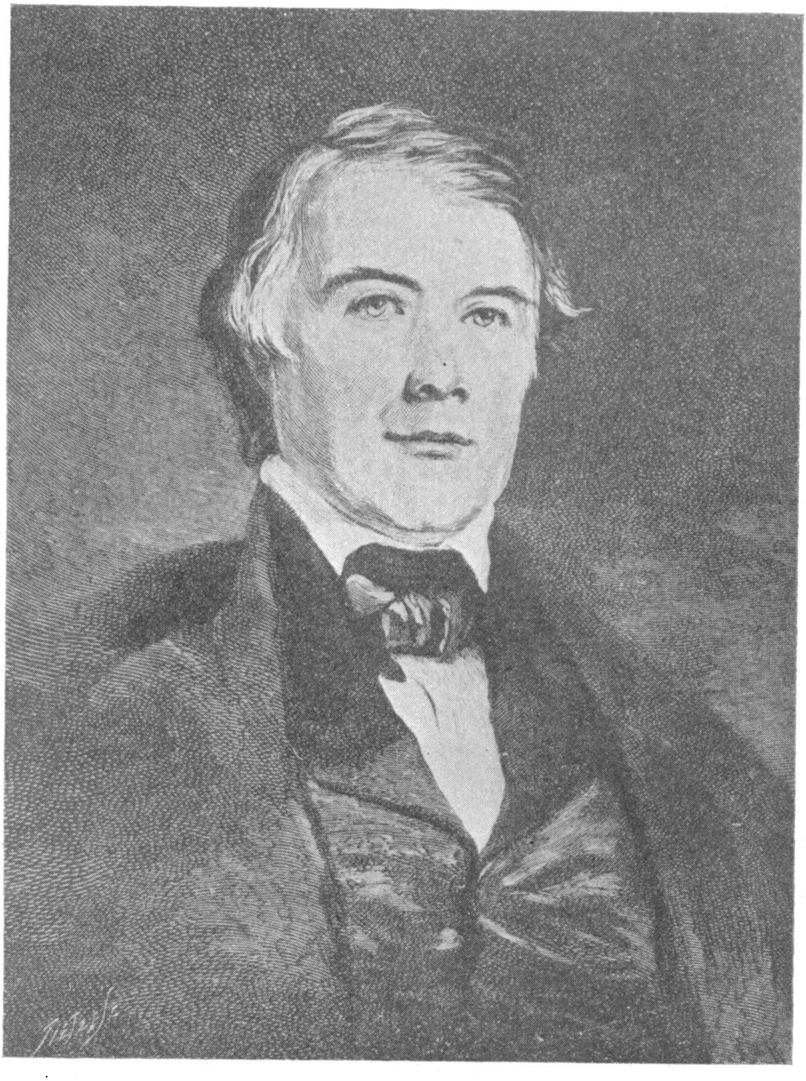
IT is not in human nature to suffer from a prolonged or repeated evil without seeking for a remedy. Severe weather of any kind—heat, cold, rain or drought—if long continued causes distress and the only way to escape the ill effects of such extremes is to control the weather, either to mitigate it when it is becoming too severe or to take proper measures in advance to secure the kind of weather that is wanted. Savages and unenlightened peoples have resorted to all sorts of charms and incantations; to medicine-men, rainmakers, rain-gods, etc. These mummeries have been the subject of many articles and some elaborate treatises. The ceremonies are often curious and ingenious; some are grossly superstitious and others are mere chicanery, but usually the method of the rainmaker among primitive folk is based on homeopathy or imitative magic—for instance, he will attempt to produce a noise like thunder with the idea that this will result in the bursting forth of the genuine article and its attendant rain; or he will subject puss to an enforced bath in spite of her repugnance to it to bring about a rain, inasmuch as when she washes her face it is a sign that rain is coming. These practices have been common also with pagan nations of the highest civilization. Jupiter Pluvius was one of the most potent of the Roman Deities, and of course when the gods controlling the elements are angry they must be propitiated by suitable ceremonies. For excessive cold we provide extra means of heating, for tornadoes cyclone cellars, excessive rainfall and floods present problems for the engineer if he would ward off the destruction they would cause; these measures have reference to individuals or to isolated places, but the actual control—the production, prevention, or moderation of any special kind of weather over large districts—has not been accomplished or even attempted in the case of heat, frost or winds, though it has been undertaken with regard to the production of rain, and, according to Professor McAdie, of the U. S. Weather Bureau, meteorologists are of the opinion that "rain-control is a scientific possibility. Successful rain engineers will come, in time, from the ranks of those who study and clearly understand the physical



(Courtesy of D. Appleton and Co.)

PORTRAIT OF JAMES POLLARD ESPY ("OLD STORM KING") process of cloud formation." The modern rainmaker therefore can be nothing if he is not scientific. He must have a scientific ground for his process however fallacious it may be.

If any one can be called the Father of the United States Weather Service, it is James Pollard Espy (1785-1860). From his meteorological studies he evolved a theory of the manner in which clouds are formed in high regions of the atmosphere and produce rain. This was to the effect, essentially, that heated air at any locality rises into rarer regions and expands; this expansion is accompanied by fall of temperature which condenses the vapor in the immediately contiguous air as well as within the ascending column; this condensation liberates sufficient heat to stimulate the further rise of the central column of air, with continuous expansion, cooling, and condensation of vapor into clouds, until they are eventually precipitated as rain.

He thought that this natural process could be accomplished artificially by maintaining large fires over extensive areas, and sought governmental aid to undertake experiments for that purpose. He cited the practice of American Indians in burning the prairies to produce rain, and his agitation of the subject attracted so much attention that numerous instances were reported which seemed to confirm his theories, but his petitions to the legislature of Pennsylvania and to Congress were humorously refused. He acquired high repute as a meteorologist in Europe as well as at home, and in 1841 he published his *Philosophy of Storms* which included his proposed method of producing rain artificially. In 1843 he was placed in charge of the meteorological work of the U. S. Signal Service, his division being known as the Meteorological Bureau of the War Department, in the conduct of which he became familiarly known as "Old Storm King"—a sobriquet which meant that if the public regarded his theories as vagaries, they thought none the less kindly of him on that account. His branch of service was afterwards transferred to the Department of Agriculture, and continued as the U. S. Weather Bureau.

Although Espy's theories are now know to be not wholly sound, their promulgation was a great incentive to further work along their line. The many instances of rain occurring either during or immediately after a severe battle or heavy cannonading had been often commented upon, and in 1871 Mr. Edward Powers published a book on "War and the Weather" containing a large collection of data to show that heavy cannonading was followed even in very dry regions by copious rainfall. He developed a theory that although concussion did not cause the formation of clouds in the surface atmosphere, which was lacking in moisture, in some way it did cause precipitation from the higher strata of air which carried moisture. His contention all turned upon the question whether, in the United States, in times of drouth at the surface of the earth, the upper air has a considerable supply of moisture derived not from surface evaporation, but brought from the Pacific ocean; that "it is not the moisture of the surface air east of the mountains that causes the rain; it is the rain that causes the moisture." The idea that at a great height there is a generally prevalent flow of air eastward and above that a stratum flowing westward is still entertained, and aviators are seeking to determine whether it is correct.

As might have been expected, Mr. Powers' theory too was pooh-poohed, but his arguments and illustrations were too cogent to be ignored, and the prospect of large financial benefit that might be obtained from a successful application of these ideas in the production of rain was alluring enough to induce capitalists to finance an attempt on a large scale. The national government went so far in its sanction of the enterprise as to authorize an expedition for the purpose of conducting experiments under the direction of General R. G. Dyrenforth. The Midland Ranch, in the northwestern part of Texas, was selected for the place to conduct the experiments, which were frequent and varied, during the period from the ninth to the twenty-fifth of August, 1891. Both the place and the season were thought to be above rather than below average dryness. The affair attracted much attention, and reports of the experiments were read eagerly throughout the whole country. Various forms of bombs and balloons were used to produce explosions and concussions at different altitudes. General Dyrenforth's report to Congress, (Senate: *Ex. Doc. No.* 45, February 25, 1892), was to the effect that the experiments were not extensive enough or sufficiently long continued to make safe deductions; and Mr. George E. Curtis, who was meteorologist for the expedition, concluded that "these experiments have not afforded any scientific standing to the theory that rain-storms can be produced by concussions." At the same time, the leaders and participants in this expedition did not think the theory was disproved, and its advocates regarded the tests as insufficient. Much discussion followed. Professor Alexander McFarlane, of the University of Texas, in a letter to the San Antonio Daily Express, of December 4, 1891, said "The trial of Friday, August 25, was a crucial test, and resulted not only in demonstrating what every person who has any sound knowledge of physics knows that it is impossible to produce rain by making a great noise, but also that even the explosion of a twelve-foot balloon inside a black rain cloud does not bring down a shower.'' This ''crucial test,'' however, was followed next day by a precipitation that was characterized by different persons as anything from a mere sprinkle to a heavy rainfall, two or three miles to the northwest of the place where the experiment was made, but in a direction in which the wind would have carried the clouds. It was not certain that the rain was due to the explosions, and it was unfortunate that the experiments resulted in this negative fashion and were inconclusive. One consequence of these efforts, especially to be noted, is related by Mr. Curtis. He calls attention to the rash conclusions that were drawn from the telegraphic and incomplete reports of the effect even of preliminary experiments and trying out of the apparatus, and adds ''charlatans and sharpers have not been slow to seize the opportunity thus afforded. Artificial rain companies have sprung up and are now (1892) busily engaged in defrauding the farmers of the semi-arid States by contracting to produce rain, and by selling rights to use their various methods.''

Thirty years have elapsed since the Dyrenforth experiments—what has become of the weather mongers' pseudo-scientific pretensions and practices? As lately as February 1, 1921, the public press reported from *Medicine Hat, Alberta,* the announcement by the United Agricultural Association that ''Rainmaker'' Hatfield *had been engaged to increase precipitation* during the dry season at the rate (*sic*) of $4,000 an inch. The ''Rainmaker'' says he can produce rainfall by chemical and other scientific methods, and is to operate over a section of about one hundred miles radius. That last is a very clever stipulation. It greatly increases his chance of success and makes it much safer for him to guarantee it, for a circle of one hundred miles radius covers just a hundred times as large an area as one of ten miles radius and gives him one hundred times as great likelihood of apparent success *somewhere,* as if the region of his efforts were the smaller district.

A sequel to this appears in later dispatches from Milwaukee, in which Wisconsin farmers are said to offer ''Rainmaker'' Hatfield $3,000 an inch for producing rain. The item states further that ''Hatfield has made rain for the farmers in three counties in Washington State, where he was paid $3,000 an inch. His rainmaking equipment consists of a huge tank 20 feet high in which Hatfield brews a mystic chemical mixture which, he says, opens up the clouds.'' (New York Times, July 27, 1921.)

There is here the same difficulty in tracing any connection between supposed cause and effect—the same kind of difficulty, that is present in the pretensions of the dowser. The operator goes through his performance, (so does the Indian medicine-man);

somewhere in some measure, rain falls; and the blunder, as old as man, of counfounding *post quod* with *propter quod,* continues.

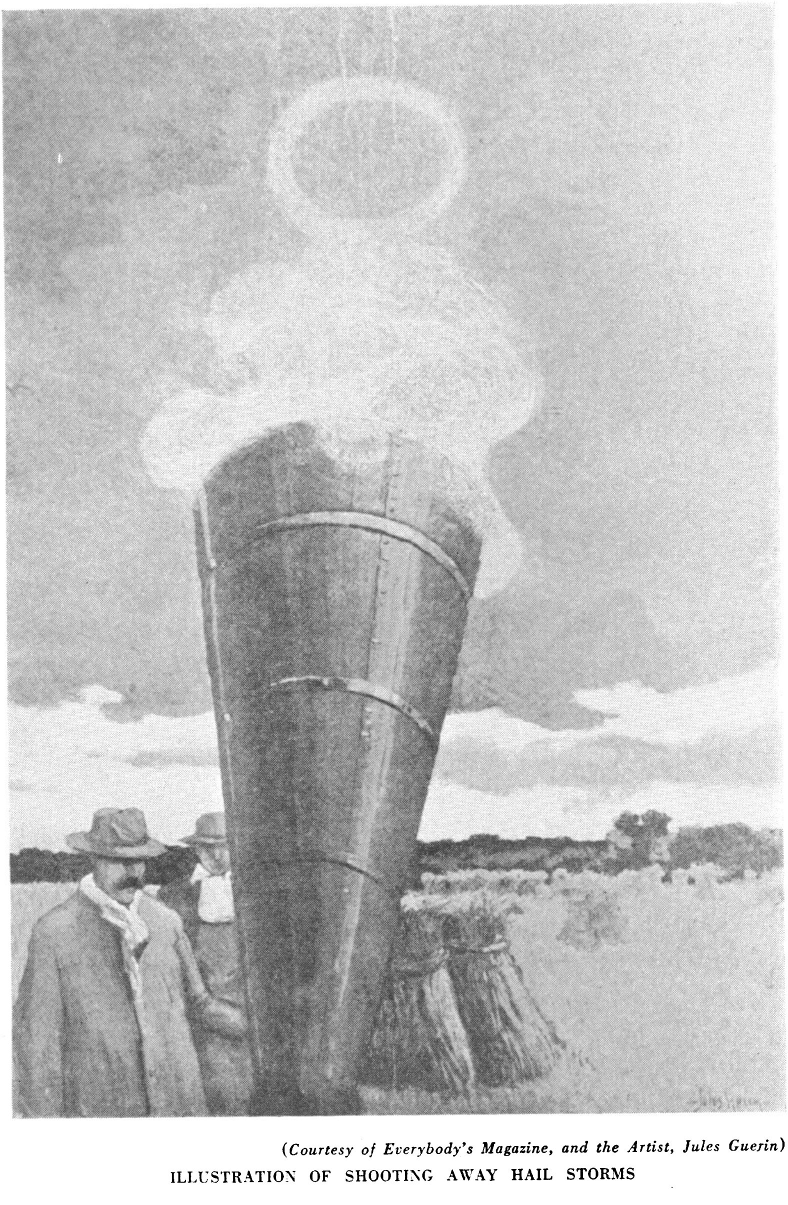
The process of passing from aqueous vapor through clouds to rain is not yet well determined and the rainmaker, who must perforce be scientific, is obliged to proceed in a manner that he can show conforms to "theory." Unfortunately there is a superabundance of theories—at least five, and all have good scientific support, while not one is conclusively established to the exclusion of the others. The rainmaker favors a combination of two; (a), that dust nuclei should be in the air, about which water vapor can gather, (smoke, either from surface fires or exploded bombs will meet this need); and (b), that jars or concussions will so jostle or disturb the air that the water particles will attach themselves to these nuclei. The process of coalescence begun, it will continue of itself although the exact reasons for so doing are not altogether understood; or at least physicists are not agreed upon them. This, however, is not the rainmaker's concern so long as they do act. Mr. McAdie flouts the concussion idea. He says "Rainmakers of our time bang and thrash the air, hoping to cause rain by concussion. They may well be compared to impatient children hammering on reservoirs in a vain endeavor to make water flow."

That was written in 1895, but in 1918, nearly a quarter of a century later, a popular old English almanac, *Raphael's Almanac or the prophetic Messenger and Weather Guide,* gives this caution to its readers:

> No reliance should be placed on weather predictions during the war, as the terrific bombardments cause violent concussions in the atmosphere, producing clouds and rain, particularly in the southeast and east of England.

Weather control by artificial means, however, is not regarded as unscientific, and meteorologists are not hopeless of ultimate success in accomplishing it, at least in producing rain. At the time of the Dyrenforth experiments the psychologist, Elmer Gates, was demonstrating in his laboratory at Chevy Chase, Maryland, the production of rain electrically. Electrifying the air at one spot, (like a limited area of the earth's surface), causes expansion by the mutual repulsion of air particles; the air becomes less dense and rises, currents thus set up encounter colder air in the upper regions, and moisture is precipitated.

Various processes for rain-making have been patented, and the business is carried on with a good deal of financial success by the dowsers of the clouds. They succeed in getting testimonials apparently with little difficulty, in which the witnesses testify to things as of their own knowledge, which occur simultaneously in places twenty miles or more apart, and similar inconsistencies.



(Courtesy of Everybody's Magazine, and the Artist, Jules Guerin)

ILLUSTRATION OF SHOOTING AWAY HAIL STORMS

When clouds take on a sinister aspect it behooves man to do what he can to fend off the injury which they threaten. A hailstorm may work havoc, and in a few minutes may wreck all the hopes which the agriculturist has erected upon the labors of an entire season. It means disaster. Especially has this been the case in the rich wine-growing districts of France, Italy and Austria. Hailstorms are not uncommon there, but familiarity does not breed contempt. The growers have learned to recognize pretty readily the signs of such storms, which cover usually a small area; and the clouds from which the hail falls are massed in a limited region or pass over a narrow strip of territory.

After various haphazard experiences of viticulturists, one of them, an Austrian, Albert Stiger, invented a form of cannon in 1896 which could be readily and effectively used for the purpose of repelling and breaking up such storms. This cannon somewhat resembles the old bell-mouthed blunderbuss in form, with a chamber at the breach for a cartridge containing only powder, and a funnel shaped tube like the cone of a megaphone. Housed in little shacks on the hillsides, these are ready for use at short notice, and since they are distributed among the many adjoining vineyards, a whole battery of them can be brought into action promptly. The grapes are maturing and the vineyards are in their most vigorous growth from July to September, just at the time of year when hailstorms are most frequent, and the workmen accordingly are alert in watching for signs of danger. When the storm is seen to be gathering, the cannons are brought out and directed against the threatening cloud. Signals are sent from vineyard to vineyard and upon the first appearance of the destructive hailstone the counter bombardment begins. From the mouth of the cannon issues a mass of heated gas, smoke and smoke rings, propelled violently against the lowering cloud. The smoke rings are like those discharged from the smoke stack by the puffs of a locomotive, but with far greater energy of propulsion. In a sense this was anticipating the war, for it was a veritable gas attack in the realm of the aeronaut. The theory of the action is not very definite or well assured. Whether the rings of smoke disrupt the clouds, or whether sufficient local heating of the air causes warm air to rise and intercept the hail, converting it into rain or preventing the congealing of water vapor into hail, is uncertain; but there seems sufficient evidence of the efficacy of the plan in dispersing the clouds and checking the storm of hail. The cannons literally *shoot it away.*